

# High Performance Multiphase Combustion Tool Using Level Set-Based Primary Atomization Coupled with Flamelet Models, Phase I

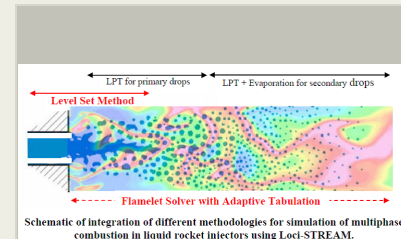
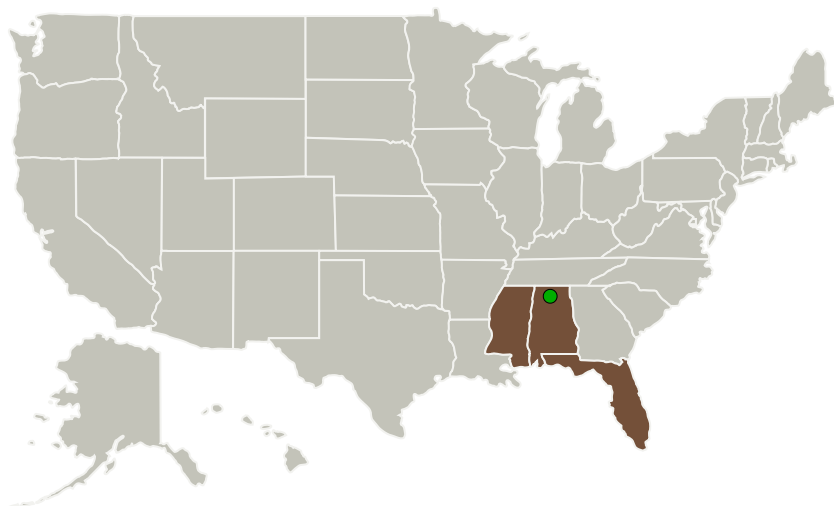
Completed Technology Project (2013 - 2014)



## Project Introduction

The innovative methodologies proposed in this STTR Phase 1 project will enhance Loci-STREAM which is a high performance, high fidelity simulation tool already being used at NASA for a variety of CFD applications. This project will address critical needs in order to enable fast and accurate simulations of liquid space propulsion systems (using propellants such as LOX, LCH<sub>4</sub>, RP-1, LH<sub>2</sub>, etc.). The proposed enhancements to Loci-STREAM in this project are: (1) Level-Set methodology (which will be of high fidelity and highly scalable for massively parallel computing) for tracking liquid propellant interface for primary atomization, and (2) Adaptive tabulation for flamelet models for turbulent combustion designed for distributed parallel computing architectures. The following methodologies are already available in Loci-STREAM: (a) Lagrangian particle tracking for motion of droplets, (b) Droplet evaporation model, and (c) Flamelet models in Hybrid RANS-LES framework for unsteady turbulent combustion. Integration of the methodologies proposed in this project into Loci-STREAM will result in a state-of-the-art multiphase combustion modeling tool which will enable fast and accurate design and analysis of liquid rocket engine flow environments, combustion stability analysis, etc. which constitute critical components of space propulsion engines that are part of NASA's Space Launch System (SLS).

## Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Streamline Numerics, Inc.	Lead Organization	Industry	Gainesville, Florida
● Marshall Space Flight Center (MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Florida
Mississippi	

## Project Transitions

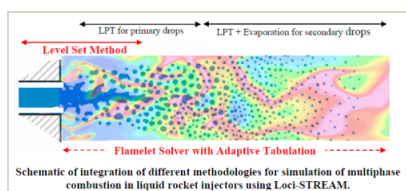
▶ **May 2013:** Project Start

✓ **May 2014:** Closed out

### Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140469>)

## Images



### Project Image

High Performance Multiphase Combustion Tool Using Level Set-Based Primary Atomization Coupled with Flamelet Models  
(<https://techport.nasa.gov/image/127459>)

## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Organization:

Streamline Numerics, Inc.

### Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

### Program Director:

Jason L Kessler

### Program Manager:

Carlos Torrez

### Principal Investigator:

Siddharth S Thakur

### Co-Investigator:

Siddharth Thakur

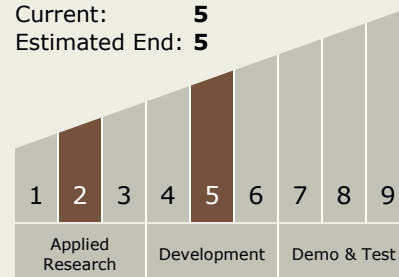
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## Technology Maturity (TRL)

Start: **2**  
Current: **5**  
Estimated End: **5**



## Technology Areas

### Primary:

- TX01 Propulsion Systems
  - └ TX01.1 Chemical Space Propulsion
    - └ TX01.1.3 Cryogenic

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System